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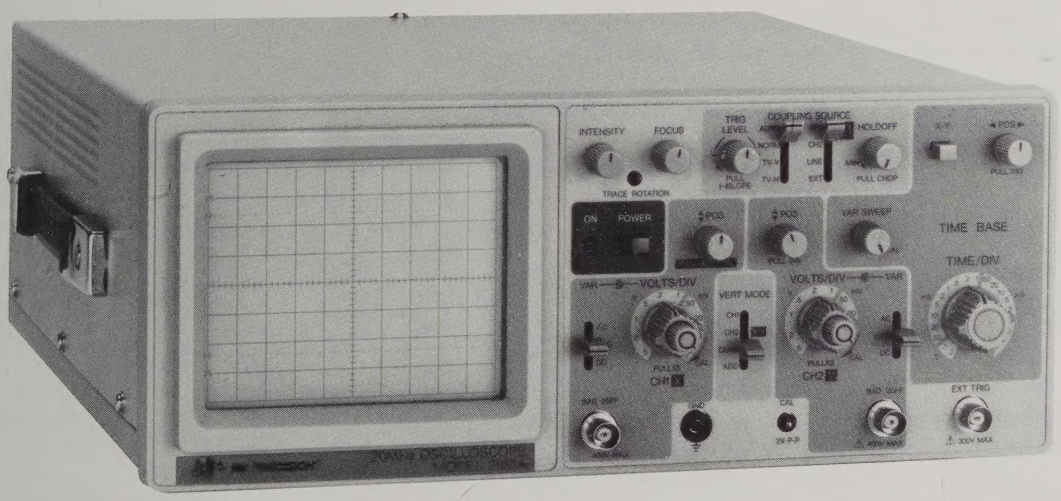
B&K PRECISION 2120A

INSTRUCTION MANUAL

BK PRECISION®

MODEL 2120A

20 MHz
DUAL-TRACE OSCILLOSCOPE



BK PRECISION®

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed high voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltage poses an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly in the equipment under test. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; make certain such surfaces are not damp or wet.
4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.
6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as the on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
7. Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result from connecting the ground lead of most test instruments (including this oscilloscope) to a "hot chassis". To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 or 1604 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
8. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

Instruction Manual

for

BK PRECISION®

Model 2120A

Dual-Trace Oscilloscope

This symbol on oscilloscope means "refer to instruction manual for further precautionary information". This symbol appears in the manual where the corresponding information is given.

BK PRECISION®

6470 West Cortland Street
Chicago, Illinois 60635

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FEATURES

UAL TRACE FEATURES

ual Trace
Model 2120A has two vertical input channels for displaying two waveforms simultaneously. Selectable single trace (either CH 1 or CH 2) or dual trace. Alternate or chop sweep selectable at all sweep rates.

ım and Difference Capability
Permits algebraic addition or subtraction of channel 1 and channel 2 waveforms, displayed as a single trace. Useful for differential voltage and distortion measurements.

RT FEATURES

ectangular CRT
Rectangular CRT with large 8 x 10 centimeter viewing area.

onvenience
Trace rotation electrically adjustable from front panel. 0%, 10%, 90%, and 100% markers for rise time measurements.

ERTICAL FEATURES

igh Sensitivity
5 mV/div sensitivity for full bandwidth; 1 mV/div at reduced bandwidth. Gain decreases with **VARIABLE** control.

alibrated Voltage Measurements
Accurate voltage measurements (±3%) on 10 calibrated ranges from 5 mV/div to 5 V/ div. Vertical gain fully adjustable between calibrated steps.

WEEP FEATURES

alibrated Time Measurements
Accurate (±3%) time measurements. Model 2120A has 20 calibrated ranges from 0.2 s/div to 0.1 µs/div. Sweep time is fully adjustable between calibrated ranges.

10 Sweep Magnification
Allows closer examination of waveforms, increases maximum sweep rate to 10 ns/div.

TRIGGERING FEATURES

Two Trigger Modes
Selectable normal (triggered) or automatic sweep modes.

Triggered Sweep
Sweep remains at rest unless adequate trigger signal is applied. Fully adjustable trigger level and (+) or (-) slope.

AUTO Sweep
Selectable AUTO sweep provides sweep without trigger input, automatically reverts to triggered sweep operation when adequate trigger is applied.

Five Trigger Sources
Five trigger source selections, including CH 1, CH 2, ALT, EXT, and LINE. In ALT mode, each waveform becomes its own trigger (alternate triggering).

Three Trigger Coupling Choices
Selectable AC, TV H (Line), or TV V (Frame) trigger coupling.

Video Sync
Frame (TV V) or Line (TV H) triggering selectable for observing composite video waveforms.

Variable Holdoff
Trigger inhibit period after end of sweep adjustable. Permits stable observation of complex pulse trains.

OTHER FEATURES

X-Y Operation
Channel 1 can be applied as horizontal deflection (X-axis) while channel 2 provides vertical deflection (Y-axis).

Built-In Probe Adjust Square Wave
A 2.0 V p-p, 1 kHz square wave generator permits probe compensation adjustment.

Supplied With Two Probes

Low Boy Configuration
Low profile housing saves bench space and allows oscilloscope to be carried like a briefcase.

SPECIFICATIONS

CRT:

Type: Rectangular with integral graticule.

Display Area: 8 x 10 div (1 div = 1 cm).

Accelerating Voltage: 2.1 kV.

Phosphor: P31.

VERTICAL AMPLIFIERS (CH 1 and CH 2)

Sensitivity:
5 mV/div to 5 V/div (X1 mode).
1 mV/div to 1 V/div (X5 mode).
1-2-5 sequence, 10 step attenuator. Vernier control provides fully adjustable attenuation between steps.

Accuracy:
±3% (X1 mode).
±5% (X5 mode).

Input Resistance:
1 MΩ ±2%.

Input Capacitance:
25 pF ±10 pF.

Frequency Response:
5 mV to 5 V/div (CAL):
DC to 20 MHz (-3 dB).
1 mV/div (CAL):
DC to 10 MHz (-3 dB).

Rise Time:
Approximately 17.5 ns.

Operating Modes:

CH 1:	CH 1, single trace.
CH 2:	CH 2, single trace.
ALT:	dual trace, alternating.
CHOP:	dual trace, chopped.
ADD:	algebraic sum of CH 1 + CH 2.

Polarity Reversal (Invert):
CH 2 only.

Maximum Input Voltage:
400 V dc + ac peak.

Maximum Undistorted Amplitude:
DC-to-20 MHz: 4 divisions.
DC-to-10 MHz: 8 divisions.

HORIZONTAL AMPLIFIER
(Input through channel 1 input)

X-Y mode: switch selectable using X-Y switch.
CH 1: X axis.
CH 2: Y axis.

Sensitivity: Same as vertical channel 2.

Accuracy:
Y-Axis: ±3%.
X-Axis: ±6%.

Input Impedance: Same as vertical channel 2.

Frequency Response:
DC to 1 MHz typical (-3 dB).

X-Y Phase Difference:
Approximately 3° at 50 kHz.

Maximum Input Voltage:
Same as vertical channel 2.

SWEEP SYSTEM

Sweep Speed:
0.1 µs/div to 0.2 s/div in 1-2-5 sequence, 20 steps. Vernier control provides fully adjustable sweep time between steps.

Accuracy: ±3%.

Sweep Magnification:
10X, ±6% (0.1 µs and 0.2 µs ranges uncalibrated when X10 is engaged).

Holdoff:
Continuously adjustable from NORM to 5 times normal.

TRIGGERING

Trigger Modes:
AUTO (free run) or NORM.

Trigger Source:
CH 1, CH 2, ALT, EXT, LINE.

Maximum External Trigger Voltage:
300 V dc + ac peak.

Trigger Coupling:

AC:	30 Hz to 30 MHz.
TV H:	Used for triggering from horizontal sync pulses.
TV V:	Used for triggering from vertical sync pulses.

Trigger Sensitivity:
Internal: 0.5 division (1 division with TV Coupling).
External: 500 mV.

OTHER SPECIFICATIONS

Calibrating Voltage:
1 kHz (nominal) Positive Square Wave, 2.0 V p-p (±3%).

Trace Rotation:
Electrical, front panel adjustable.

Power Requirements:
100, 120, 220, 240 V ±10%, 50/60 Hz, approximately 40 W.

Dimensions:
324 x 132 x 398 mm (12.8 x 5.2 x 15.6").

Weight:
Approximately 7.6 kg (16.75 lbs).

SUPPLIED ACCESSORIES:
Two Probes.
Schematic Diagram and Parts List.
AC Power Cord.

OPTIONAL ACCESSORIES:
10:1 Probe, Model PR-46.
100:1 Probe, Model PR-100.

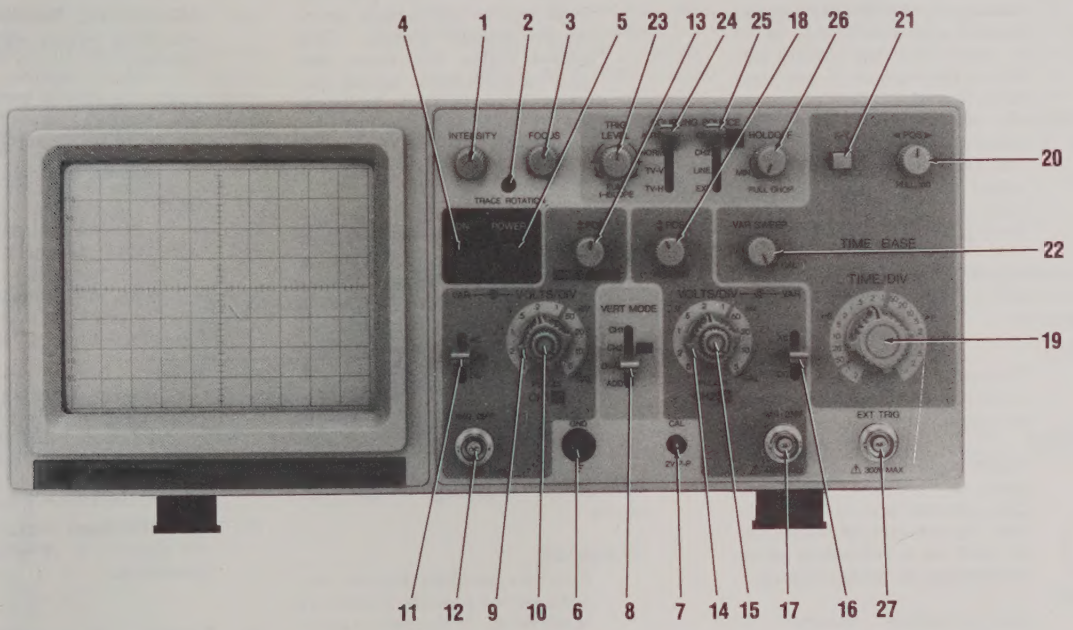

Fig. 1. Front Panel Controls And Indicators.

GENERAL FUNCTION CONTROLS

1. **INTENSITY Control.** Adjusts brightness of trace.

2. **TRACE ROTATION Control.** Use to adjust trace to a horizontal position.

3. **FOCUS Control.** Adjusts trace focus.

4. **ON Indicator.** Lights when oscilloscope is "on".

5. **POWER Pushbutton.** Turns oscilloscope "on" and "off".

6. ⏚ **Terminal.** Oscilloscope chassis ground, and earth ground via three-wire ac power cord.

7. **CAL Terminal.** Terminal provides a 2.0 V p-p, 1 kHz (nominal) square wave signal. This signal is useful for probe compensation adjustment, as well as checking vertical calibration.

VERTICAL CONTROLS

8. **VERTical MODE Switch.** Selects display mode. Four-position switch with the following positions:

CH 1:
Channel 1 (X) input is displayed.

CH 2:
Channel 2 (Y) input is displayed. Additionally, set switch in this position when using "X-Y" operation.

DUAL:
Both Channel 1 and Channel 2 inputs are displayed simultaneously using two separate traces.

ADD:
Channel 1 input is summed with Channel 2 input. Sum signal is displayed. When Channel 1 signal is INVerted, subtracts Channel 1 from Channel 2; difference is displayed.

CHANNEL 1 CONTROLS

9. **CH 1 VOLTS/DIV Control.** Vertical attenuator for channel 1. Provides step adjustment of vertical sensitivity. When channel 1 **VARIABLE** control is set to **CAL**, vertical sensitivity is calibrated in 10 steps from 5 mV/div to 5 V/div in a 1-2-5 sequence. When the X-Y mode of operation is selected, this control provides step adjustment of X-axis sensitivity.

10. **VARIABLE Control, PULL X5 MAG:**

VARIABLE:
Rotation provides vernier adjustment of channel 1 vertical sensitivity. In the fully clockwise (CAL) position, the attenuator is calibrated. Counterclockwise rotation decreases gain sensitivity. In X-Y operation, this control becomes the vernier X-axis sensitivity control.

PULL X5 MAG:
Selects five-times vertical sensitivity when control is pulled to "out" position. Increases maximum vertical sensitivity to 1 mV/div.

11. **AC-GND-DC Switch.** Three-position lever switch which operates as follows:

AC:
Channel 1 input signal is capacitively coupled; dc component is blocked.

GND:
Opens signal path and grounds input to vertical amplifier. This provides a zero-volt base line, the position of which can be used as a reference when performing dc measurements.

DC:
Direct-couples channel 1 input signal; both ac and dc component of signal produce vertical deflection.

12. **CH 1 (X) Input Jack.** Vertical input for channel 1. X axis input for X-Y operation.

13. **▲▼POSition Control, PULL ALTernate TRIGger:**

POS:
Rotation adjusts vertical position of channel 1 trace.

PULL ALT TRIG:
When set to "out" position, both inputs alternately serve as the trigger source. This allows stable dual-trace display of waveforms having dissimilar periods. **SOURCE** switch must be set to **CH 1.**

CHANNEL 2 CONTROLS

14. **CH 2 VOLTS/DIV Control.** Vertical attenuator for channel 2. Provides step adjustment of vertical sensitivity. When channel 2 **VARIABLE** control is set to **CAL,** vertical sensitivity is calibrated in 10 steps from 5 mV/div to 5 V/div in a 1-2-5 sequence. In X-Y operation, this control provides step adjustment of Y-axis sensitivity.

15. **VARIABLE Control, PULL X5 MAG:**

VARIABLE:
Rotation provides vernier adjustment of channel 2 vertical sensitivity. In the fully clockwise (CAL) position, the attenuator is calibrated. Counterclockwise rotation decreases gain sensitivity. In X-Y operation, this control becomes the vernier Y-axis sensitivity control.

PULL X5 MAG:
Selects five-times vertical sensitivity when control is pulled to "out" position. Increases maximum vertical sensitivity to 1 mV/div.

16. **AC-GND-DC Switch.** Three-position lever switch which operates as follows:

AC:
Channel 2 input signal is capacitively coupled; dc component is blocked.

GND:
Opens signal path and grounds input to vertical amplifier. This provides a zero-volt base line, the position of which can be used as a reference when performing dc measurements.

DC:
Direct coupling of channel 2 input signal; both ac and dc component of signal produce vertical deflection.

17. **CH 2 (Y) Input Jack.** Vertical input for channel 2. Y-axis input in X-Y operation.

18. **▲▼POSition Control, PULL INVert:**

▲▼POS:
Rotation adjusts vertical position of channel 2 trace.

PULL INV:
Inverts polarity of CH 2 input.

HORIZONTAL CONTROLS

19. **Sweep TIME/DIV Control.** Provides step selection of sweep rate. When the **VARIABLE** sweep control is set to **CAL,** sweep rate is calibrated. The control has 20 steps from 0.1 µs/div to 0.2 s/div, in a 1-2-5 sequence.

20. **◄► X POSition Control, PULL X10:**

◄► X POS:
Rotation allows horizontal positioning of trace.

PULL 10X MAG:
Selects ten times sweep magnification when set to "out" position, normal when pushed in. Increases maximum sweep rate to 10 ns/div.

21. **X-Y Pushbutton.** When pushbutton is engaged (along with **Trigger SOURCE** and **VERT MODE** switches set to "X-Y"), the X-Y mode is selected. The channel 1 input becomes the X-axis and the channel 2 input becomes the Y-axis. Disengage for normal operation.

22. **VARiable SWEEP Control.** Rotation of control is vernier adjustment for sweep rate. In fully clockwise (CAL) position, sweep rate is calibrated.

TRIGGERING CONTROLS

23. **TRIGger LEVEL Control, PULL (-) SLOPE:**

TRIG LEVEL:
Trigger level adjustment; determines the point on the trigger source waveform where the sweep is triggered. Rotation in the counterclockwise direction selects more negative point of triggering; rotation in the clockwise direction selects a more positive point of triggering.

PULL (-) SLOPE:
When the control is set to the "out" position, negative-going slope is selected as trigger. With control set to "in" position, positive-going slope is selected as trigger.

24. **Trigger COUPLING Switch.** Selects trigger coupling. Four-position switch with the following positions:

AUTO:
Automatic triggering selected. In automatic triggering mode, sweep is generated in absence of adequate trigger signal; automatically reverts to triggered sweep operation when adequate trigger signal is present.

NORM:
Normal triggering selected. In normal triggering mode, sweep is only generated when adequate trigger signal is present.

TV-V:
Trigger is ac-coupled through low-pass filter. Useful for triggering from TV vertical sync pulses.

TV-H:
Trigger is ac-coupled through high-pass filter. Useful for triggering from TV horizontal sync pulses.

25. **Trigger SOURCE Switch.** Selects trigger source. Four-position switch with the following positions:

CH 1:
Selects channel 1 as the triggering source, regardless of the **VERT MODE** setting. When **PULL ALT TRIG** is also pulled out, alternate triggering is selected in dual trace operation.

CH 2:
Selects channel 2 as the triggering source, regardless of the **VERT MODE** setting.

LINE:
Line voltage derived signal serves as trigger.

EXT:
Signal from **EXT TRIG** jack serves as trigger.

26. **HOLDOFF Control, PULL CHOP:**

HOLDOFF:
Rotation of control adjusts the holdoff time (the trigger inhibit period beyond sweep duration). When the control is rotated fully counterclockwise, the holdoff is set to normal. The holdoff period increases with clockwise rotation to a maximum of five-times normal.

PULL CHOP:
Selects chop method of dual-trace display.

27. **EXT TRIGger jack.** External trigger input.

REAR PANEL CONTROLS

8. **Fuse Holder/Line Voltage Selector.** Contains fuse and selects line voltage.

9. **Power Cord Receptacle.**

30. **Tilt Stand.** (Not Shown). With stand in retracted position, scope rests on foot pads. Swivel stand away from chassis for tilted position.

SAFETY PRECAUTIONS

WARNING

The following precautions must be observed to help prevent electric shock.

1. When the oscilloscope is used to make measurements in equipment that contains high voltage, there is always a certain amount of danger from electrical shock. The person using the oscilloscope in such conditions should be a qualified electronics technician or otherwise trained and qualified to work in such circumstances. Observe the TEST INSTRUMENT SAFETY recommendations listed on the inside front cover of this manual.

2. Do not operate this oscilloscope with the case removed unless you are a qualified service technician. High voltage up to 2,100 volts is present when the unit is operating with the case removed.

3. The ground wire of the 3-wire ac power plug places the chassis and housing of the oscilloscope at earth ground. Use only a 3-wire outlet, and do not attempt to defeat the ground wire connection or float the oscilloscope; to do so may pose a great safety hazard.

4. Special precautions are required to measure or observe line voltage waveforms with any oscilloscope. Use the following procedure:

   a. Do not connect the ground clip of the probe to either side of the line. The clip is already at earth ground and touching it to the hot side of the line may "weld" or "disintegrate" the probe tip and cause possible injury, plus possible damage to the scope or probe.

   b. Insert the probe tip into one side of the line voltage receptacle, then the other. One side of the receptacle should be "hot" and produce the waveform. The other side of the receptacle is the ac return and no waveform should result.

EQUIPMENT PROTECTION PRECAUTIONS

CAUTION

The following precautions will help avoid damage to the oscilloscope.

1. Never allow a small spot of high brilliance to remain stationary on the screen for more than a few seconds. The screen may become permanently burned. A spot will occur when the scope is set up for X-Y operation and no signal is applied. Either reduce the intensity so the spot is barely visible, apply signal, or switch back to normal sweep operation. It is also advisable to use low intensity with **AUTO** triggering and no signal applied for long periods. A high intensity trace at the same position could cause a line to become permanently burned onto the screen.

2. Do not obstruct the ventilating holes in the case, as this will increase the scope's internal temperature.

3. Excessive voltage applied to the input jacks may damage the oscilloscope. The maximum ratings of the inputs are as follows:

   CH 1 and CH 2:
   400 V dc + ac peak.
   EXT TRIG:
   300 V dc + ac peak.

4. Always connect a cable from the ground terminal of the oscilloscope to the chassis of the equipment under test. Without this precaution, the entire current for the equipment under test may be drawn through the probe clip leads under certain circumstances. Such conditions could also pose a safety hazard, which the ground cable will prevent.

5. The probe ground clips are at oscilloscope and earth ground and should be connected only to the earth ground or isolated common of the equipment under test. To measure with respect to any point other than the common, use CH 1 - CH 2 subtract operation (**ADD** mode and **PULL INV**), with the channel 1 probe to the point of measurement and the channel 2 probe to the point of reference. Use this method even if the reference point is a dc voltage with no signal.

OPERATING TIPS

The following recommendations will help obtain the best performance from the oscilloscope.

1. Always use the probe ground clips for best results, attached to a circuit ground point near the point of measurement. Do not rely solely on an external ground wire in lieu of the probe ground clips as undesired signals may be introduced.

2. Avoid the following operating conditions:
   a. Direct sunlight.
   b. High temperature and humidity.
   c. Mechanical vibration.
   d. Electrical noise and strong magnetic fields, such as near large motors, power supplies, transformers, etc.

3. Occasionally check trace rotation, probe compensation, and calibration accuracy of the oscilloscope using the procedures found in the MAINTENANCE section of this manual.

4. Terminate the output of a signal generator into its characteristic impedance to minimize ringing, especially if the signal has fast edges such as square waves or pulses. For example, the typical 50 Ω output of a square wave generator should be terminated into an external 50 Ω terminating load and connected to the oscilloscope with 50 Ω coaxial cable.

5. Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation should be adjusted initially, then the same probe always used with the same channel. Probe compensation should be readjusted when a probe from a different oscilloscope is used.

INITIAL STARTING PROCEDURE

Until you familiarize yourself with the use of all controls, the settings given here can be used as a reference point to obtain a trace on the CRT in preparation for waveform observation.

1. Press the **POWER** pushbutton; red **ON** indicator lights when scope is "on".

2. The **VERT MODE** switch should be set to **CH 1** and the **Trigger COUPLING** switch should be set to **AUTO**.

3. A trace should appear on the CRT. Adjust the trace brightness with the **INTENSITY** control, and the trace sharpness with the **FOCUS** control.

INGLE TRACE DISPLAY

Either channel 2 or channel 1 may be sed for single-trace operation. The dvantage of using channel 2 is that the aveform on the display can be inverted f desired with the ▲▼**POS/PULL INV** con-rol.

1. Perform the steps of the "Initial Starting Procedure" with the **VERT MODE** switch set to **CH 2**.

2. Connect the probe to the **CH 2 (Y)** input jack.

3. Connect the probe ground clip to the chassis or common of the equipment under test. Connect the probe tip to the point of measurement.

4. If no waveform appears, increase the sensitivity by turning the **CH 2 VOLTS/ DIV** control clockwise to a position that gives 2 to 6 divisions vertical deflection.

5. The display on the CRT may be unsynchronized. Refer to the "Triggering" paragraphs in this section for procedures on setting triggering and sweep time controls to obtain a stable display showing the desired number of waveforms.

UAL TRACE DISPLAY

In observing simultaneous waveforms n channel 1 and 2, the waveforms are sually related in frequency, or one of ne waveforms is synchronized to the ther, although the basic frequencies are ifferent. If the two waveforms have no hase or frequency relationship, there is eldom reason to observe both wave-orms simultaneously. However, when ne trigger ▲▼**POS/PULL ALT TRIG** con-ol is set to the **ALT TRIG** position, two aveforms not related in frequency or eriod can be simultaneously viewed.

1. Connect probes to both the **CH 1 (X)** and **CH 2 (Y)** input jacks.

2. Connect the ground clips of the probes to the chassis or common of the equipment under test. Connect the tips of the probes to the two points in the circuit where waveforms are to be measured.

3. When the **VERT MODE** switch is set to **ADD**, the algebraic sum of CH 1 + CH 2 is displayed as a single trace. When the **PULL INV** switch is also engaged, the algebraic difference of CH 1 - CH 2 is displayed.

4. To view both waveforms simultaneously, set the **VERT MODE** switch to **DUAL**. Alternate triggering is automatically selected. **CHOP** triggering can be selected by pulling the **HOLDOFF/PULL CHOP** control.

5. In the **ALT** mode, one sweep displays the channel 1 signal and the next sweep displays the channel 2 signal in an alternating sequence. Alternate sweep is normally used for viewing high-frequency or high-speed waveforms at sweep times of 1 ms/div and faster, but may be selected at any sweep time. However, it should be noted that **phase comparisons** between the two displayed waveforms cannot be accurately made using **ALT TRIG.**

6. In the **CHOP** mode, the sweep is chopped (switched) between channel 1 and channel 2. Using **CHOP**, one channel does not have to "wait" for a complete swept display of the other channel. Therefore, portions of both channel's waveforms are displayed with the phase relationship between the two waveforms unaltered. Chop sweep is normally used for low-frequency or low-speed waveforms at sweep times of 1 ms/div and slower; or where phase relationship between channel 1 and channel 2 require measurement.

   a. If chop sweep is used at sweep times of 0.2 ms/div and faster, the chop rate becomes a significant portion of the sweep and may become visible in the displayed waveform. However, you may select chop sweep at any sweep time for special applications.

   b. Note that this oscilloscope is not intended to be used with the **CHOP** display mode and the **ALT** triggering source mode selected simultaneously. It may be impossible to synchronize the display with this combination. Use the **ALT TRIG** mode instead or select a trigger **SOURCE** of **CH 1** or **CH 2**.

7. Adjust the channel 1 and 2 **POS** controls to place the channel 1 trace above the channel 2 trace.

8. Set the **CH 1** and **CH 2 VOLTS/DIV** controls to a position that gives 2 to 3 divisions of vertical deflection for each trace. If the display on the screen is unsynchronized, refer to the "Triggering" paragraphs in this section of the manual for procedures for setting triggering and sweep time controls to obtain a stable display showing the desired number of waveforms.

TRIGGERING

The Model 2120A Oscilloscope provides versatility in sync triggering for ability to obtain a stable, jitter-free display in single-trace, or dual-trace operation. The proper settings depend upon the type of waveforms being observed and the type of measurement desired. An explanation of the various controls which affect synchronization is given to help you select the proper setting over a wide range of conditions.

Trigger COUPLING Switch

1. Normal triggered sweep operation is available with the switch set in the **NORM** position. The sweep remains at rest until the selected trigger source signal crosses the threshold level set by the **TRIG LEVEL** control. The trigger causes one sweep to be generated, after which the sweep again remains at rest until triggered. In the normal triggering mode, there will be no trace unless an adequate trigger signal is present. In the **ALT TRIGGER MODE** of dual trace operation with the **COUPLING** switch also set to **NORM**, there will be no trace unless both channel 1 and channel 2 signals are adequate for triggering. Typically, signals that produce even 1/2 division of vertical deflection are adequate for normal triggered sweep operation.

2. With the **COUPLING** switch set to the **AUTO** position, automatic sweep operation is selected. In automatic sweep operation, the sweep generator free runs to generate a sweep without a trigger signal. However, it automatically switches to triggered sweep operation if an acceptable trigger source signal is present. The **AUTO** position is handy when first setting up the scope to observe a waveform; it provides sweep for waveform observation until other controls can be properly set. Once the controls are set, operation is often switched back to the normal triggering mode, since it is more sensitive. Automatic sweep must be used for dc measurements and signals of such low amplitude that they will not trigger the sweep.

4. The **TV-H** and **TV-V** positions are primarily for viewing composite video waveforms. Horizontal sync pulses are selected as trigger when the trigger **COUPLING** switch is set to the **TV-H** position, and vertical sync pulses are selected as trigger when the trigger **COUPLING** switch is set to the **TV-V** position. The **TV-H** and **TV-V** positions may also be used as low frequency reject and high frequency reject coupling respectively (with a cut off frequency of about 400 Hz). Additional procedures for observing video waveforms are given later in this section of the manual.

Trigger SOURCE Switch

The trigger **SOURCE** switch (**CH 1, CH 2,** etc.) selects the signal to be used as the sync trigger.

1. If the **SOURCE** switch is set to **CH 1** (or **CH 2**) the channel 1 (or channel 2) signal becomes the trigger source regardless of the **VERT MODE** selection. **CH 1,** or **CH 2** are often used as the trigger source for phase or timing comparison measurements.

2. If the **SOURCE** switch is set to the **LINE** position, a line-frequency derived signal serves as trigger.

3. If the **SOURCE** switch is set to the **EXT** position, the signal applied to the **EXT TRIG** jack becomes the trigger source. This signal must have a timing relationship to the displayed waveforms for a synchronized display.

4. When using dual trace operation with **NORM** triggering coupling, the **ALT** position must be selected. Additionally, signal must be applied to both inputs for proper operation.

TRIG LEVEL/PULL (-) SLOPE Controls
(Refer to Fig. 2)

A sweep trigger is developed when the trigger source signal crosses a preset threshold level. Rotation of the **TRIG LEVEL** control varies the threshold level. In the + direction, the triggering threshold shifts to a more positive value, and in the - direction, the triggering threshold shifts to a more negative value. When the control is centered, the threshold level is set at the approximate average of the signal used as the triggering source. Proper adjustment of this control usually synchronizes the display.

The **TRIG LEVEL** control adjusts the start of the sweep to almost any desired point on a waveform. On sine wave signals, the phase at which sweep begins is variable. Note that if the **TRIG LEVEL** control is rotated toward its extreme + or - setting, no sweep will be developed in the normal trigger mode because the triggering threshold exceeds the peak amplitude of the sync signal.

When the **SLOPE** control is set to the + ("in") position, the sweep is developed from the trigger source waveform as it crosses a threshold level in a positive-going direction. When the **SLOPE** control is set to the - ("out") position, a sweep trigger is developed from the trigger source waveform as it crosses the threshold level in a negative-going direction.

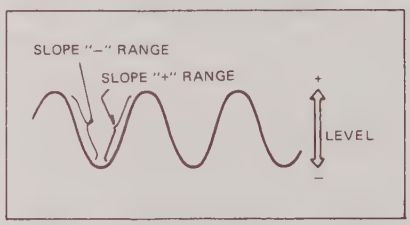

Fig. 2. Function of Slope and Level Controls.

Sweep TIME/DIV Control

Set the sweep **TIME/DIV** control to display the desired number of cycles of the waveform. If there are too many cycles displayed for good resolution, switch to a faster sweep time. If only a line is displayed, try a slower sweep time. When the sweep time is faster than the waveform being observed, only part of it will be displayed, which may appear as a straight line for a square wave or pulse waveform.

MAGNIFIED SWEEP OPERATION

Since merely shortening the sweep time to magnify a portion of an observed waveform can result in the desired portion disappearing off the screen, such magnified display should be performed using magnified sweep.

Using the ◀▶ **X POS** control, adjust the desired portion of waveform to the center of the CRT. Pull out the **PULL X10** knob to magnify the display ten times. For this type of display the sweep time is the sweep **TIME/DIV** setting divided by 10. Rotation of the ◀▶**X POS** control can then be used to select the desired portion of the waveforms.

X-Y OPERATION

X-Y operation permits the oscilloscope to perform many measurements not possible with conventional sweep operation. The CRT display becomes an electronic graph of two instantaneous voltages. The display may be a direct comparison of the two voltages such as stereoscope display of stereo signal outputs. However, the X-Y mode can be used to graph almost any dynamic characteristic if a transducer is used to change the characteristic (frequency, temperature, velocity, etc.) into a voltage. One common application is frequency response measurements, where the Y axis corresponds to signal amplitude and the X axis corresponds to frequency.

1. Set the **VERT MODE** switch to the **X-Y** (CH 2) position.

2. Set the **Trigger SOURCE** switch to the **X-Y** (CH 1) position.

3. Press the **X-Y** pushbutton. In this mode, channel 2 becomes the Y axis input and channel 1 becomes the X axis input.

4. The X and Y positions are now adjusted using the ◀▶ **POS** and the channel 2 (Y)▲▼**POS** controls respectively.

5. Adjust the amount of horizontal (X axis) deflection with the **CH 1 VOLTS/DIV** and **VARIABLE** controls.

6. Adjust the amount of vertical (Y axis) deflection with the **CH 2 VOLTS/DIV** and **VARIABLE** controls.

VIDEO SIGNAL OBSERVATION

Setting the **COUPLING** switch to the **TV-H** or **TV-V** position permits selection of horizontal or vertical sync pulses for sweep triggering when viewing composite video waveforms.

When the **TV-H** mode is selected, horizontal sync pulses are selected as triggers to permit viewing of horizontal lines of video. A sweep time of about 10 µs/div is appropriate for displaying lines of video. The **VAR SWEEP** control can be set to display the exact number of waveforms desired.

When the **TV-V** mode is selected, vertical sync pulses are selected as triggers to permit viewing of vertical fields and frames of video. A sweep time of 2 ms/div is appropriate for viewing fields of video and 5 ms/div for complete frames (two interlaced fields) of video.

At most points of measurement, a composite video signal is of the (-) polarity, that is, the sync pulses are negative and the video is positive. In this case, use **(-) SLOPE.** If the waveform is taken at a circuit point where the video waveform is inverted, the sync pulses are positive and the video is negative. In this case, use **(+) SLOPE.**

WARNING

The following instructions are for use by qualified service personnel only. To avoid electrical shock, do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

High voltage up to 2,100 volts is present when covers are removed and the unit is operating. Remember that high voltage may be retained indefinitely on high voltage capacitors. Also remember that ac line voltage is present on line voltage input circuits any time the instrument is plugged into an ac outlet, even if turned off. Unplug the oscilloscope and discharge high voltage capacitors before performing service procedures.

FUSE REPLACEMENT

If the fuse blows, the "ON" indicator will not light and the oscilloscope will not operate. The fuse should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse, then replace only with the correct value fuse. For 115 V line voltage operation, use a 800 mA, 250 V fuse (B & K part number 194-031-9-001). For 230 V line voltage operation, use a 400 mA, 250 V fuse (B & K part number 194-032-9-001). The fuse is located on the rear panel adjacent to the power cord receptacle.

Remove the fuseholder assembly as follows:

1. Unplug the power cord from rear of scope.
2. Insert a small screwdriver in fuseholder slot (located between fuseholder and receptacle). Pry fuseholder away from receptacle.
3. When reinstalling fuseholder, be sure that the fuse is installed so that the correct line voltage is selected (see LINE VOLTAGE SELECTION).

LINE VOLTAGE SELECTION

To select the desired line voltage, simply insert the fuse and fuse holder so that the appropriate voltage is at the top (pointed to by the arrow). Be sure to use the proper value fuse (see label on rear panel).

PERIODIC ADJUSTMENTS

Probe compensation and trace rotation adjustments should be checked periodically and adjusted if required. These procedures are given below.

Probe Compensation

1. Connect probes to **CH 1** and **CH 2** input jacks. Perform procedure for each probe, one probe at a time.
2. Touch tip of probe to **CAL** terminal.
3. Adjust oscilloscope controls to display 3 or 4 cycles of **CAL** square wave at 5 or 6 divisions amplitude.
4. Adjust compensation trimmer on probe for optimum square wave (minimum overshoot, rounding off, and tilt). Refer to Fig. 3.

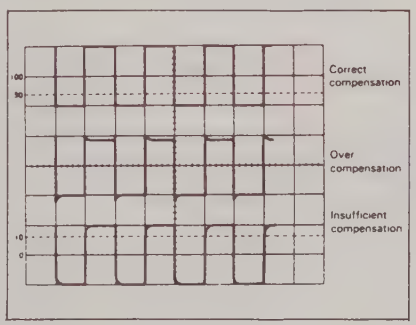

Fig. 3. Probe Compensation Adjustment.

Trace Rotation Adjustment

1. Set oscilloscope controls for a single trace display in **CH 1** mode, and with the channel 1 **AC-GND-DC** switch set to **GND**.
2. Use the channel 1 ▲▼ **POS**ition control to position the trace over the center horizontal line on the graticule scale. The trace should be exactly parallel with the horizontal line.
3. Use the **TRACE ROTATION** adjustment on the front panel to eliminate any trace tilt.

CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the **CAL** terminal on the screen. This terminal provides a square wave of 2.0 V p-p. This signal should produce a displayed waveform amplitude of four divisions at 0.5 V/div sensitivity for both channel 1 and 2 (with probes set for direct). With probes set for 10:1, there should be four divisions amplitude at 50 mV/div sensitivity. The **VARIABLE** controls must be set to **CAL** during this check.

NOTE

The **CAL** signal should be used only as a general check of calibration accuracy, not as a signal source for performing recalibration adjustments; a voltage standard calibrated at several steps and of ± 0.5% or better accuracy is required for calibration adjustments (the B & K-Precision Model 1400 Oscilloscope Calibrator is ideally suited for this).

The CAL signal should not be used as a time base standard.

INSTRUMENT REPAIR SERVICE

Because of the specialized skills and test equipment required for instrument repair and calibration, many customers prefer to rely upon **B & K-Precision** for this service. We maintain a network of **B & K-Precision** authorized service agencies for this purpose. To use this service, even if the oscilloscope is no longer under warranty, follow the instructions given in the WARRANTY SERVICE INSTRUCTION portion of this manual. There is a nominal charge for instruments out of warranty.

WARRANTY INFORMATION

LIMITED TWO-YEAR WARRANTY

MAXTEC INTERNATIONAL CORPORATION warrants to the original purchaser that its **B & K-Precision** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of two years from the date of purchase.

MAXTEC will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B & K-Precision** service contractor or the factory service department, accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty registration card to **B & K-Precision**, 6470 West Cortland Street, Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

MAXTEC shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your **B & K-Precision** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B & K-Precision** Service Department, 6470 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

B & K-Precision Test Instruments warrants products sold only in the U.S.A. and its overseas territories. In other countries, each distributor warrants the **B & K-Precision** products which it sells.

WARRANTY SERVICE INSTRUCTIONS
(For U.S.A. and its Overseas Territories)

1. Refer to the MAINTENANCE section of your **B & K-Precision** instruction manual for adjustments that may be applicable.

2. If the above-mentioned does not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred in U.S.A.) to the nearest **B & K-Precision** authorized service agency (see list enclosed with unit).

If your list of authorized **B & K-Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write to:

B & K-Precision, Factory Service Operations
Maxtec International Corporation
6470 West Cortland Street
Chicago, Illinois 60635
Tel (312) 889-1448

Also use this address for technical inquiries
and replacement parts orders.

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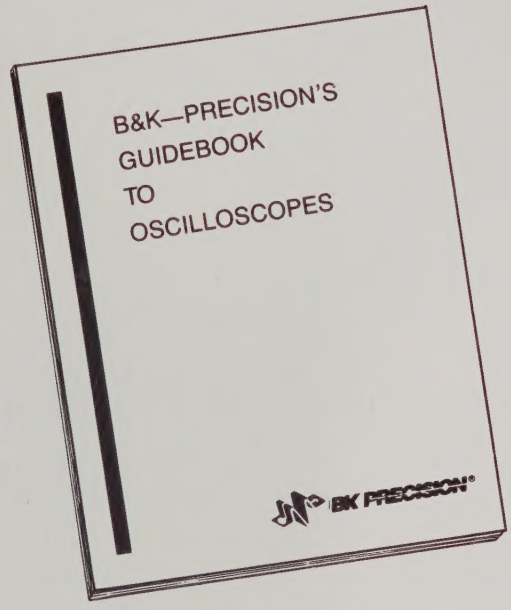

A copy of the "B & K-Precision's Guidebook To Oscilloscopes" Applications Manual is offered FREE to purchasers of B & K-Precision Oscilloscopes

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